CHAPTER 41

OAK TYPE

TYPE DESCRIPTION

The Vegetation of Wisconsin (Curtis, 1959) divides Wisconsin into two floristic provinces based on climatic conditions. The following descriptions of community types refer to this division as being either north or south of Wisconsin's Vegetative Tension Zone (Figure 41.1).

A. Dry Southern Hardwoods

Includes dry upland sites where **bur oak** (*Quercus macrocarpa*), **black oak** (*Q. velutina*), **northern pin oak** (*Q. ellipsoidalis*), or **white oak** (*Q. alba*) are dominant. Associated species include **shagbark hickory** (*Carya ovata*), **black cherry** (*Prunus serotina*), **aspen** (*Populus* spp.), and **paper birch** (*Betula papyrifera*).

B. Dry Northern Hardwoods

This community type corresponds to the scrub oak cover type. Refer to Chapter 43 for scrub oak type description and management recommendations.

Habitat types within this moisture regime include QAE, QGCe, AQV, QAp, PAm, and PMV (Kotar et al., 1988).

C. Dry-Mesic Southern Hardwoods

Includes upland sites where **red oak** (*Q. rubra*) or **white oak** dominate. Associated species may include **basswood** (*Tilia americana*), **shagbark hickory**, **black cherry**, **red maple** (*Acer rubrum*), and **black walnut** (*Juglans nigra*).

D. Dry-Mesic Northern Hardwoods

Includes upland sites with sandy loam to silt loam soils where **red oak**, **white pine** (*Pinus strobus*), **aspen**, **paper birch**, and **red maple** dominate. **White oak** and many of the **northern hardwood species** (basswood, ash, sugar maple, etc.) are also found on these sites.

Habitat types within this moisture regime include PAm, AVDe, AA, PMV, AVVib, and AQVib (Kotar et al., 1988).

E. Mesic Southern Hardwoods

Includes moist upland sites where **sugar maple** (*A. saccharum*) and **basswood** are dominant. Associated species include **red oak**, **black cherry**, **ironwood** (*Ostrya virginiana*), **white ash** (*Fraxinus americana*), and **red maple**.

F. Mesic Northern Hardwoods

Includes upland sites with loamy sands to silt loams where **red oak** and most **northern hardwood species**, especially sugar maple, dominate. **White oak**, **American elm** (*Ulmus americana*), **American beech** (*Fagus grandifolia*), and **hemlock** (*Tsuga canadensis*) are also common on many of these sites.

Habitat types found in this moisture regime include ACaCi, ATD, AViO, ATM, AH, and AFD (Kotar et al., 1988).

SILVICAL CHARACTERISTICS[*]

Species	Red oak	Black oak	White oak	Bur oak
Flowers (All monoecious)	April-May	April-May	April-May	May-June
Fruit Ripens	2nd year, Sept.-Oct.	2nd year, Sept.-Oct.	1st year, Sept.-Oct.	1st year, Aug.-Nov.
Seed Dispersal	Sept.-Dec.	Nov.-Dec.	Sept.-Oct.	Aug.-Nov.
Seed Bearing Age (years):				
Minimum	25	20	35	35
Optimum	50+	40-75	50+	75-150
Interval between seed crops	2 to 5 years	2 to 3 years	4 to 10 years	2 to 3 years
Germination:				Spring(north)
Season	Spring	Spring	Fall	Fall (south)
Cold Stratification	30 to 45 days	30 to 60 days	0 days	30 to 60 days (north)
Temp.	>34°F	65-80°F	50-65°F	60-80°F
Seed Viability	58 percent	47 percent	50-99 percent	45 percent
Shade Tolerance	Intermediate	Intolerant to intermediate	Intermediate (tolerant when young)	Intermediate
Major Pests	Oak Pest Management Guidelines are included at the end of this chapter.			

[*] Data compiled from Fowells (1965), Core (1971), Godman and Mattson (1981), Johnson et al. (1984), Minckler (1957), Sander (1957).

MANAGEMENT ALTERNATIVES

The management objective should be determined in relation to other land management objectives using the habitat type as the preferred indicator of site potential. Possible management alternatives include:

- Maintaining oak to produce the maximum quantity and quality of sawtimber and veneer within ecological and economic limitations.
- Allowing natural conversion to other successional forest types.
- Forcing type conversion to other species.

SILVICULTURAL SYSTEM

Oak maintenance utilizing even-age management techniques, using clearcutting and shelterwood harvesting techniques. Intermediate thinnings used to maximize the quantity and quality of a stand's oak component.

MANAGEMENT RECOMMENDATIONS

The following recommendations are based on the assumption that the management objective is to maintain an oak timber type.

If timber production is the primary goal, the stand should have a site index of 55 or greater (site index curves for northern red oak are presented in Figure 41.2 for northern Wisconsin and upper Michigan, and Figure 41.3 for southwestern Wisconsin). Stands with a lower site index should be converted to a more suitable species for the habitat type (e.g., pines) or managed for pulpwood.
On mesic sites with a large component of more shade tolerant species, it may be economically infeasible to manage and maintain oak. Such stands should be managed as northern hardwoods (see Chapter 40) or central hardwoods.

A. Seedling/Sapling Stands (0-5" DBH)

Release oak 4 to 5 years after the overstory has been removed (later release could result in reduced growth and possible loss of reproduction). The number of oak stems required to provide a fully stocked stand for the final harvest is listed in Table 41.1 (see also Sander et. al., 1984). Dominant and co-dominant oak stems should be encouraged and released from direct crown competition. Do not attempt to eliminate all undesirable stems.

B. Pole Stands (5-11" DBH)

Fully stocked stands should be thinned to no less than the B-level of the stocking charts shown in Figure 41.4 and 41.5. Favor dominants, seed-origin oak, and quality stump-origin sprouts. Discriminate against shade tolerant species.

NOTE: On northern dry-mesic sites, red oak should be thinned before age 50 and before stands become overstocked (see Figure 41.4 and 41.5). Dominant and co-dominant trees in overstocked stands suffer appreciable reduction in relative crown size and may not respond to thinning. Non-commercial thinnings in these stands might not be justifiable economically. White oak and swamp white oak (*Q. bicolor*), however, tolerate competition and will respond to release as late as 100 years of age.

C. Sawtimber Stands (>11" DBH)

For stands younger than the desired rotation age or rotation diameter as indicated in Table 41.2, continue to thin stands to no less than the B-level (Figure 41.4 and 41.5). Always initiate thinnings before the A-level is reached. Discriminate against shade tolerant species. The interval of such thinnings will vary, depending on the growth potential of the site and the residual stocking following the last cut (10 to 20 years).

Stop thinnings at approximately three-fourths of the desired rotation age (this will reduce the understory competition at the time of the regeneration harvest).

D. Regeneration Techniques -- Mature Timber

"No scientifically based prescription for naturally regenerating red oak is available for any of the major forest types in which it occurs," said Paul Johnson in 1986. However, the following prescriptions have been successful on some sites in the past.

As current oak stands mature and these techniques, or combinations thereof, are implemented on a greater variety of habitat types and geographical areas within the state, results may become more predictable. Correlation of results with habitat type is essential. Consequently, it is very important that all regeneration techniques currently being utilized in oak stands be documented. This record keeping will help reduce the time period required to refine these recommendations. When the effects of a prescription have been determined, submit a narrative of your documentation to the State Forest Ecologist.

1. Oak reproduction is adequate.

    a) The required quantity of advance oak reproduction varies by aspect and location on the slope. Seedling height is also important. Table 41.1 summarizes the suggested number of seedlings required to produce a fully stocked

stand of oak. Fewer seedlings per acre are acceptable if an adequate number of stump sprouts are anticipated or if intensive release cuttings are scheduled. See Sander (1977), Sander et al. (1984), and Sander et al. (1976).

b) Implement harvest by clearcutting all merchantable and non-mer-chantable trees larger than five inches in diameter.

c) Cut all trees, except oak, that are 1 to 5 inches in diameter.

d) Apply herbicide to stumps of unwanted species to prevent re-sprouting (optional).

e) Maintain adequate growing space around all oak seedlings until they become dominant.

2. Oak reproduction is not adequate (see Addendum on page 41-5; Sander (1977), Sander et al. (1984), and Sander et al. (1976); and Table 41.1).

Shelterwood Harvest

a) Initiate a two-cut shelterwood harvest, leaving 60 to 70 percent crown closure. Discriminate against all species except oak. (Only consider removing high value trees first if threatened by insect or disease.) Since the genetic variability in oak is significant, it is imperative that the most desirable oak (form and quality) provide the seed source for the next stand. It is desirable to cut in autumn, prior to freeze-up, and in conjunction with a good acorn crop.

b) Cut understory of 1 to 5-inch diameter trees to maintain the desired crown closure.

c) If a fair to poor acorn crop is expected, complete the initial shelterwood cut. Herbicide treatment of the competitive, woody vegetation will be needed when a good acorn crop is anticipated. It is critical that site preparation be coordinated with a good acorn crop. Cutting may be carried out within four years of the good acorn crop.

d) Acorns germinate best in moist well-aerated soil. Scarification will be required when leaf litter or sod is restrictive.

e) Optional reinforcement planting: hand plant between 100 and 200 oak seedlings per acre. Seedlings must have stem calipers of at least three-eighths inch, and well-developed lateral roots.

f) Complete harvest cut within two years of oak seedling establishment. See Table 41.1.

g) Maintain adequate growing space around all oak seedlings until they become dominant.

Pre-herbicide/Clearcut/Plant

a) Prior to the harvest, spray all vegetation less than four inches in diameter with an herbicide in late summer. Protection for any advance oak reproduction may be desirable. Saplings may be mechanically root sprung instead of being sprayed.

b) Clearcut all trees two inches and larger in diameter.

c) Scarify at least 50 percent of the site if sod or leaf litter is restrictive or if logging was carried out during the winter.

d) In the scarified areas hand plant between 200 and 600 oak seedlings per acre. The number of seedlings required will be affected by the number of stump sprouts anticipated. Seedlings must have a stem caliper of at least three-eighths inch. At this caliper, 2.6 seedlings are required to produce one final tree. If cutting coincides with a bumper acorn crop, planting will not be needed.

e) Maintain adequate growing space around all oak seedlings until they become dominant.

Pre-herbicide/Shelterwood/Plant (see Johnson et al., 1984)

a) Prior to harvest, spray all vegetation less than four inches in diameter with an herbicide in late summer. Protection of any advance oak reproduction may be desirable. Saplings may be mechanically root sprung instead of being sprayed.

b) Initiate a two-cut shelterwood harvest, leaving 50 to 80 percent crown closure. Understory competition determines the amount of crown closure -- with less competition potential, more sunlight is acceptable.

c) Hand plant between 200 and 600 seedlings per acre. The number of seedlings required will be affected by the number of stump sprouts anticipated. Seedlings must have a final stem caliper of at least three-eighths inch. At this caliper, 2.6 seedlings are required to produce one final tree. If cutting coincides with a bumper acorn crop, fewer seedlings will need to be planted.

d) During dormancy after the third growing season, complete the shelterwood harvest. Three growing seasons are desirable in order for seedlings to develop strong root systems.

e) Maintain adequate growing space around all oak seedlings until they become dominant.

Addendum
Evaluating the Adequacy of Oak Advance Reproduction
(excerpted from Minckler (1957), p. 30-32)

To evaluate whether the oak advance reproduction can adequately reproduce the stand, a survey must be made. This survey can be made with the inventory to determine stand stocking and quality. In fact, the number of overstory trees per acre from the stand stocking inventory is needed to estimate the number of stump sprouts per acre necessary to compensate for oak advance reproduction deficiencies. The sample form (Figure 41.6) can be used to record the tree count needed for estimating the number of overstory trees per acre.

Use the following procedure developed by Sander et al. (1976) for evaluating oak advance reproduction:

1. Take 10 or more 10-factor angle gauge sample points in the stand. At each sample point, tally the trees on a 1/20-acre plot by species and size class (see the sample tally form for overstory inventory Figure 41.6).

2. Select the number of 1/735 acre plots (4.3 feet in radius) to be used in the advance reproduction inventory from the following tabulation according to the acreage of the stand being examined:

For stand size (acres)	Use this number of 1/735-acre plots
<10	25
10 to 30	40
30 to 50	60

3. Distribute these 1/735-acre plots uniformly throughout the stand.

4. On each 1/735-acre plot look for oak reproduction stems 4.5 feet tall or taller and less than 2.0 inches in diameter at the ground line or not over 1.5 inches DBH (stems larger than this should be considered part of the overstory and tallied as such, even if below the main canopy). If at least one such stem is present, record the plot as stocked. If no such stem is present, record the plot as not stocked (see right margin of sample form, Figure 41.6).

5. Compute the percent of plots stocked. If 59 percent or more are stocked, there is adequate oak advance reproduction present; no further calculations are necessary and the stand may be harvested.

6. If fewer than 59 percent of the plots are stocked, oak advance reproduction is inadequate to reproduce the stand if it is cut. However, the stand could still be reproduced if enough stumps of the overstory oaks will sprout after they are cut. An example of how to compute the expected number of stump sprouts follows:

   a) Assume that the inventory of plots provides the data on the sample tally form (Figure 41.6).

   b) Note that there are 26 black oaks, 2 to 5 inches in diameter, per acre. Multiply 26 by 0.85 (from Table 41.3) to find how many of the 26 stumps would be expected to sprout (26 x 0.85 = 22). Note that 22, the number of expected stump sprouts per acre for 2 to 5-inch black oaks, is listed at the bottom of Figure 41.6.

   c) Similarly, compute the expected number of stump sprouts for the other size classes of black oak (in this example, 5 for the 6 to 11-inch class, and 4 for the 12 to 16-inch class) and note that all these classes sum to 31. Do the same for all oak species.

   d) Summing size classes for all oaks gives a total of 124 expected oak stump sprouts per acre.

7. Go to the tabulation below and from the percent of stocked 1/735-acre plots (determined under point 4 above) find the number of stump sprouts required to meet minimum stocking requirements at the next percent below the calculated percentage (e.g., if 43 percent is calculated, use 40 percent to find the stump sprouts required). Opposite 40, note that 95 stump sprouts are needed to make up the deficiency in advance reproduction.

Stocked 1/735 acre lots (percent)*	Stump sprouts required (number per acre)
59	0
55	19
50	44
45	69
40	95
35	120
30	145
25	170
20	196
15	221
10	246

* If the percent of stocked plots lies between the 5-percent intervals, use the lower figure, e.g., 43 percent stocked plots should be considered 40 percent.

8. Because the computed value (124) exceeds the tabulation value (95), there will be enough oak stump sprouts to make up the advance reproduction deficiency. Thus, the oak component of the new stand will be adequate and the old stand can be harvested.

9. If the number of expected stump sprouts does not compensate for advance reproduction deficiencies, harvesting should be delayed until adequate oak advance reproduction is established and reaches the minimum size of 4.5 feet in height.

10. Unless the stand is protected or wildlife is controlled, it will probably be impossible to get adequate natural oak reproduction in areas where deer browsing is heavy and where there are high populations of acorn-consuming wildlife. The alternative is to plant oak seedlings and protect them from wildlife.

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Technical Note No. 485. April 4, 1957. USDA-Forest Service, Lakes States For. Exp. Sta.: St. Paul, MN.

Figure 41.1 Vegetative tension zone of Wisconsin (Curtis, 1959).

Summary of range limits for 182 species. The figures in each county indicate the number of species attaining a range boundary there. The shaded band is the tension zone. Its exact location was determined from the densest concentration of individual range lines.

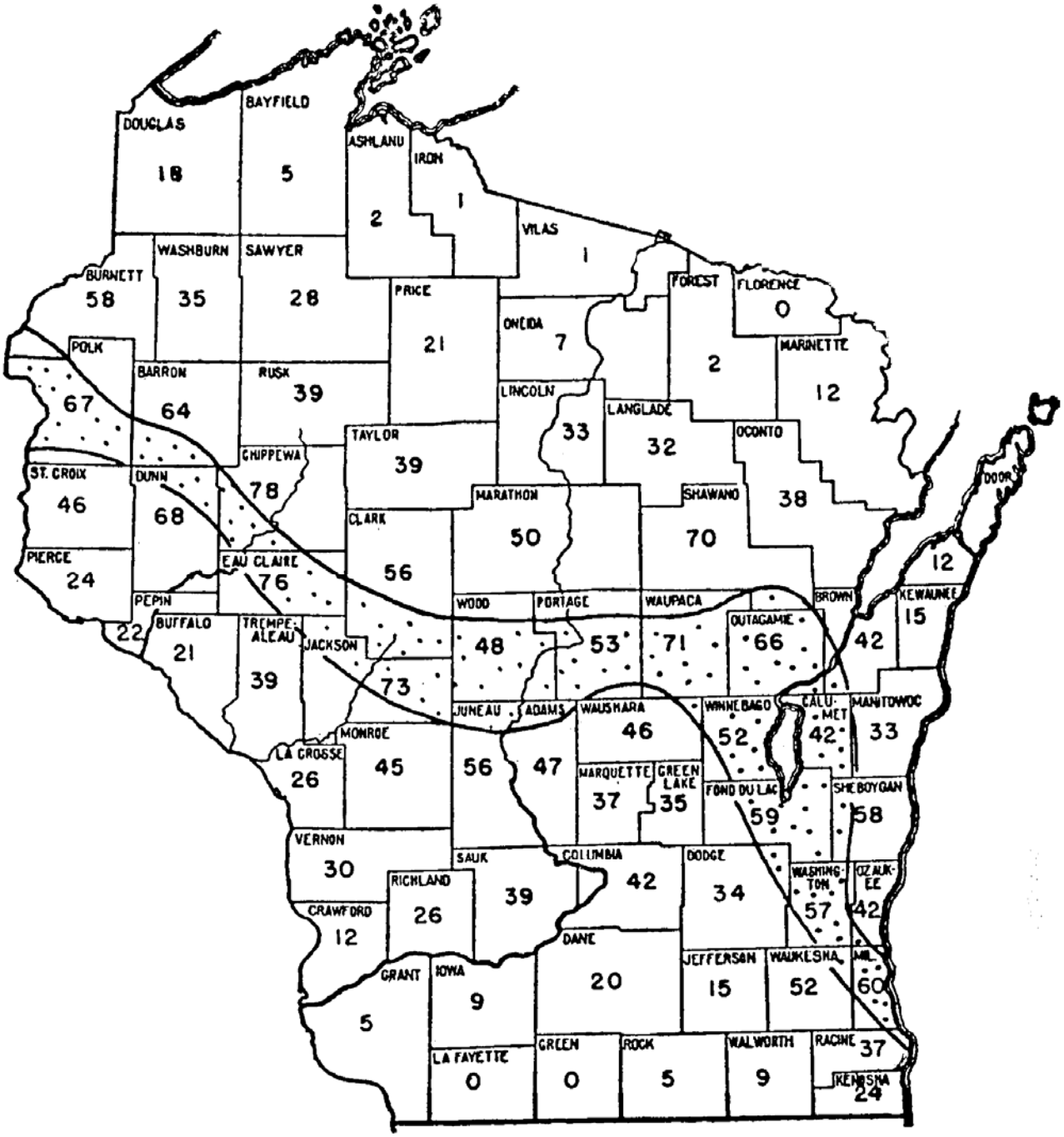
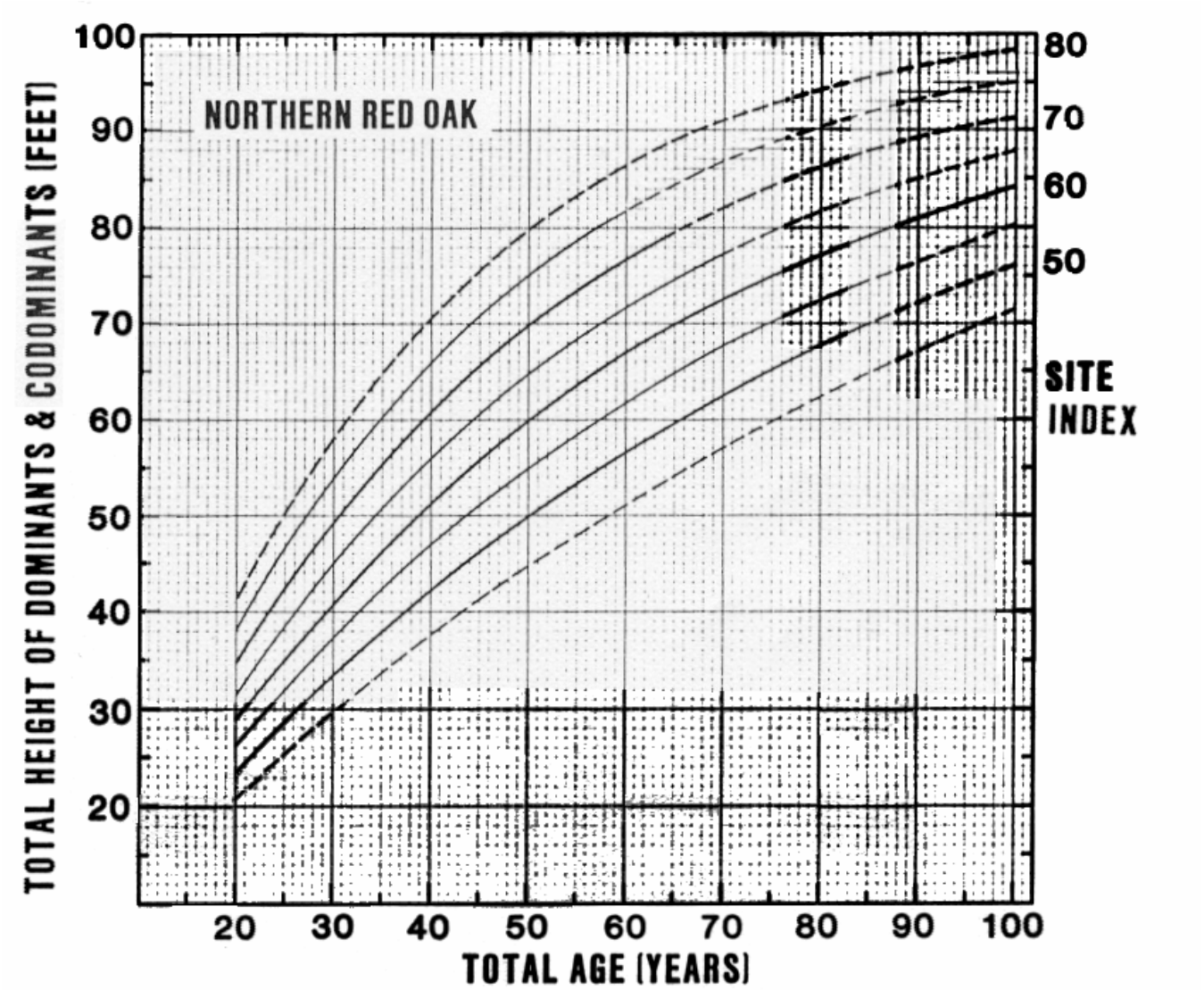


Figure 41.2 Site index curves for northern red oak in northern Wisconsin and upper Michigan (Carmean et al., 1989).

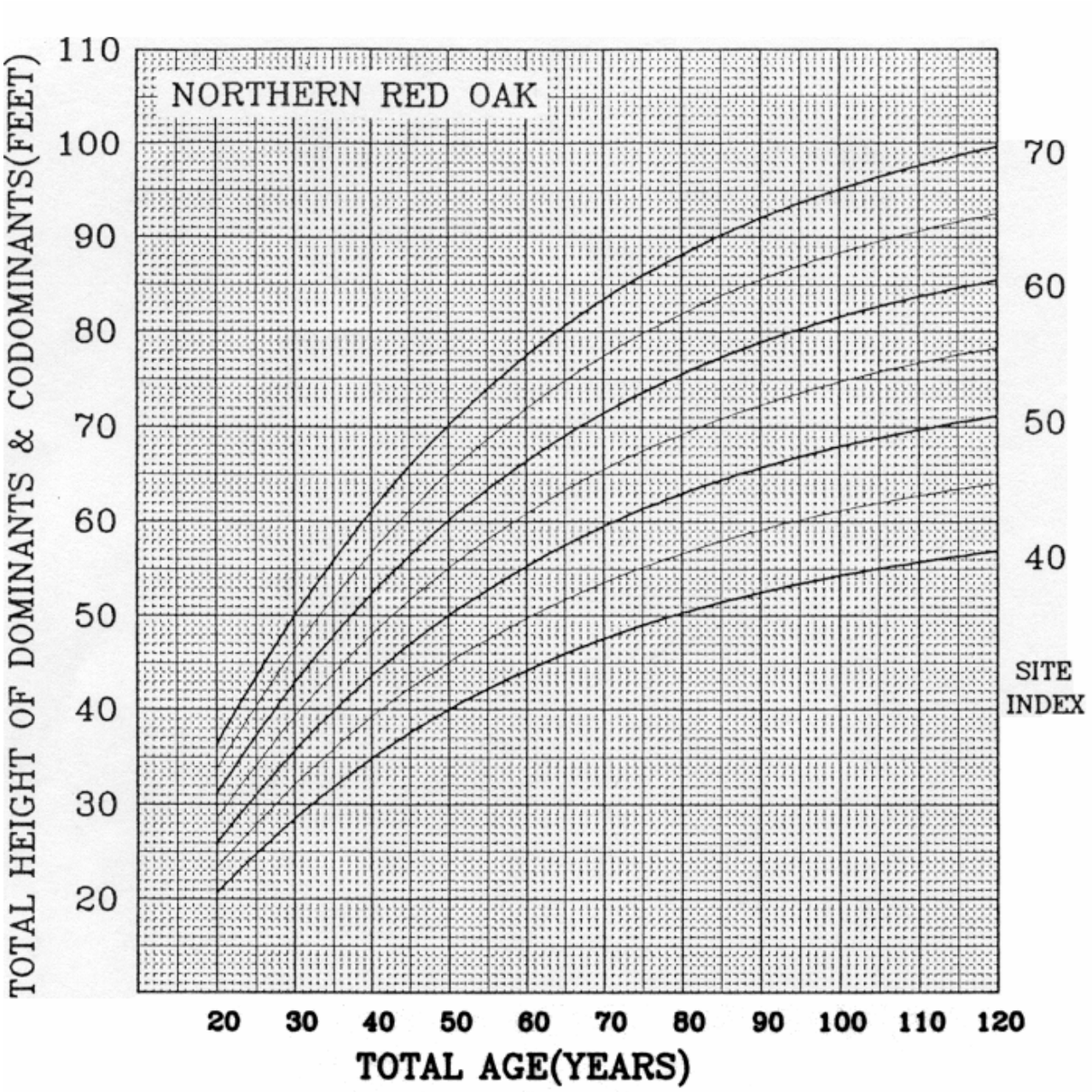
Rotation age: All sites -- 80 to 100 years



Northern red oak (Carmean 1978)
Northern Wisconsin and Upper Michigan
37 plots having 136 dominant and codominant trees
Stem analysis, nonlinear regression, polymorphic
Add 4 years to d.b.h. age to obtain total age (BH = 0.0)

	b_1	b_2	b_3	b_4	b_5	R^2	SE	Maximum difference
H	6.1785	0.6619	-0.0241	25.0185	-0.7400	0.99	1.32	4.9
SI	0.1692	1.2648	-0.0110	-3.4334	-0.3557	0.97	2.09	7.8

Figure 41.3 Site index curves for northern red oak in southwestern Wisconsin (Carmean et al., 1989).



Northern red oak (Gevorkiantz 1957b)
Southwestern Wisconsin
Number of plots and number of dominant and codominant trees not given
Total height and total age, anamorphic, equation not given
Add 4 years to d.b.h. age to obtain total age (BH = 0.0)

	b_1	b_2	b_3	b_4	b_5	R^2	SE	Maximum difference
H	1.5403	1.0006	-0.0216	1.0616	-0.0044	0.99	0.86	0.7
SI	1.0000	0.9058	-0.0269	-0.5382	0.2108	0.98	1.19	3.4

Figure 41.4 **Relation of basal area, number of trees and average tree diameter to stocking percent. For average tree diameters of 7 to 15 inches (average tree diameter corresponds to a tree with the average basal area) (Sander, 1977).**

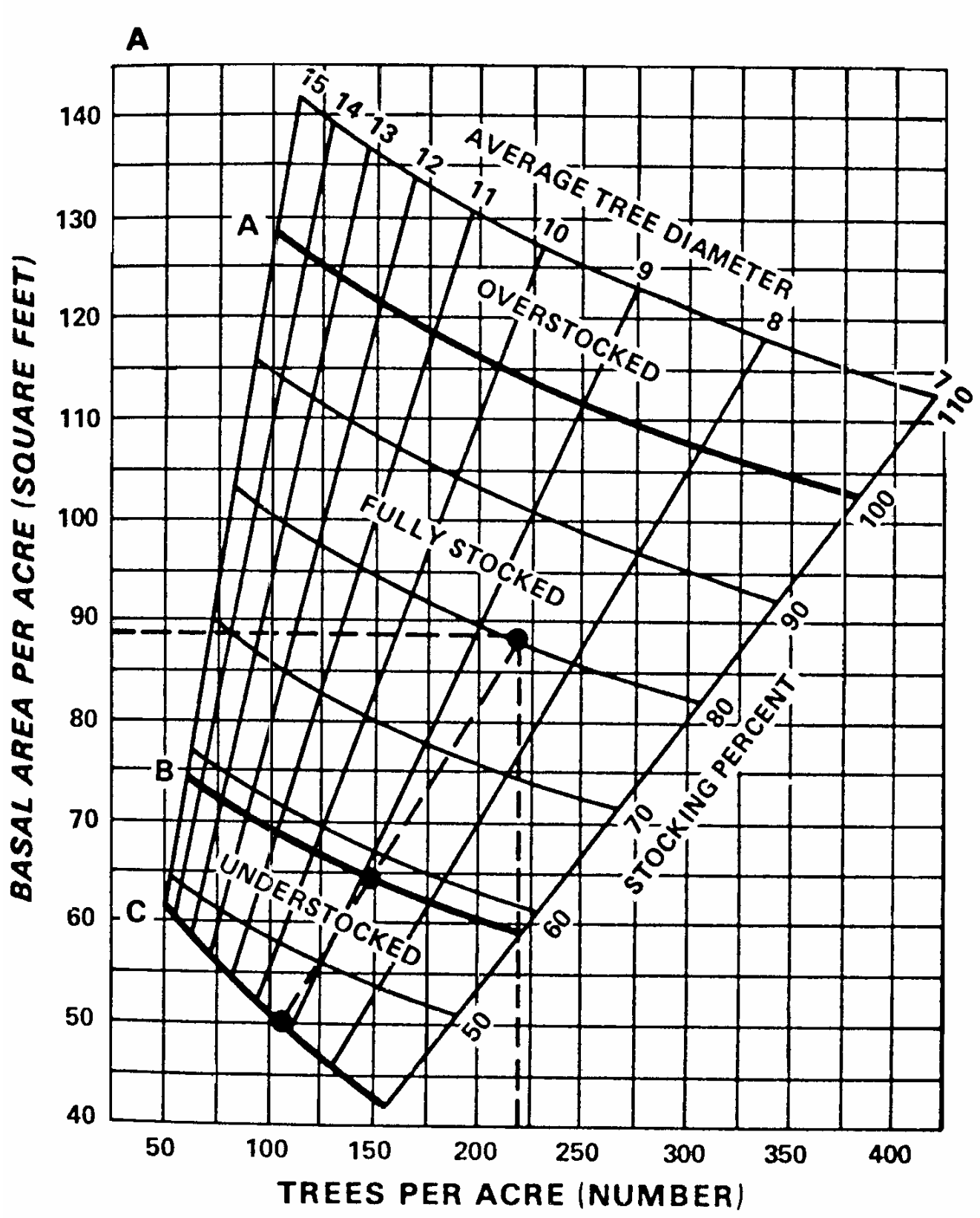


Figure 41.5 **Relation of basal area, number of trees and average tree diameter to stocking percent. For average tree diameters of 3 to 7 inches (average tree diameter corresponds to a tree with the average basal area) (Sander, 1977).**

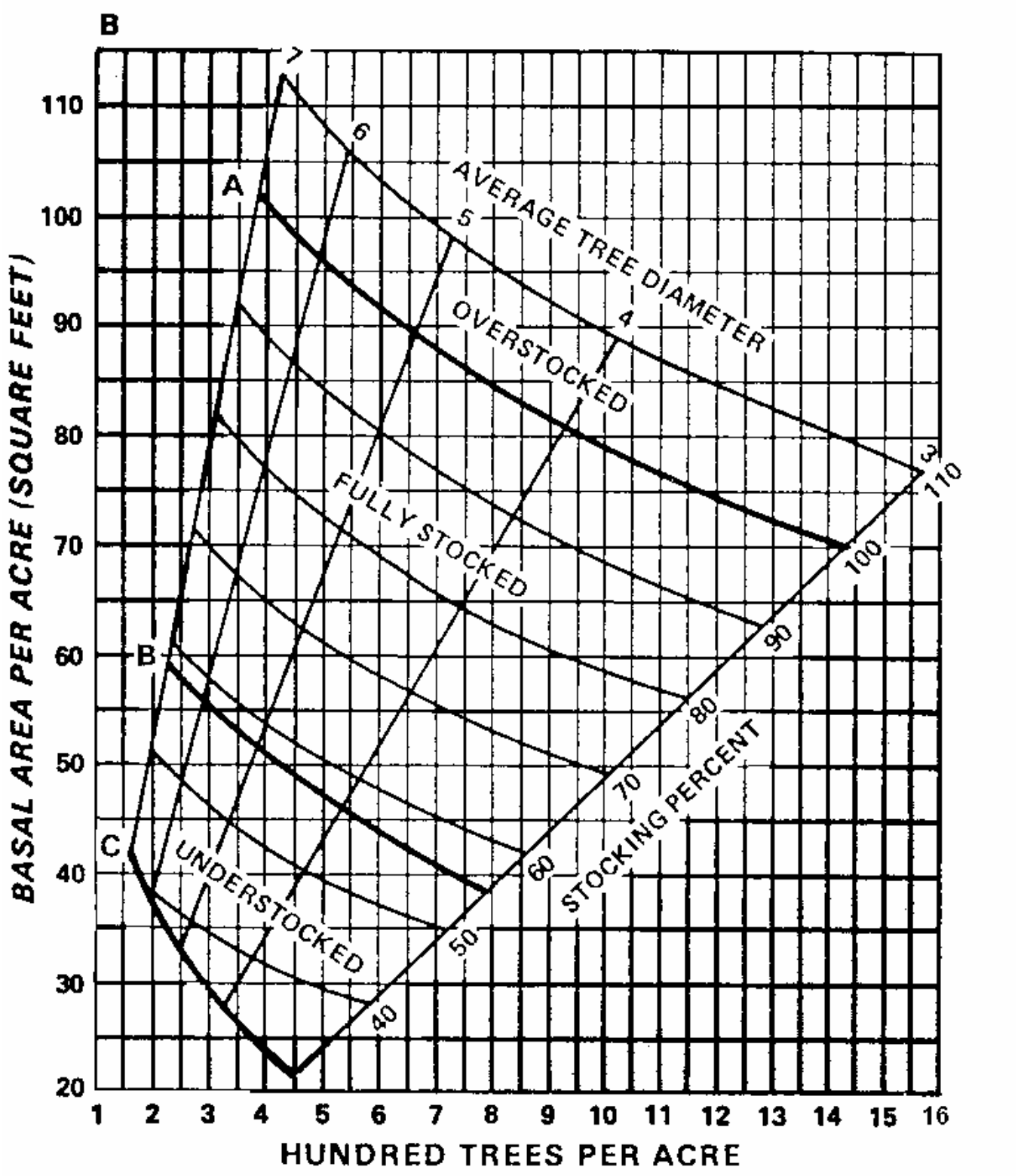


Figure 41.6 Sample tally form for recording seedling numbers on 1/20-acre plots, and the number of 1/735-acre plots that are stocked with advance oak reproduction (Sander, 1977).

Sample point number	Dbh class	Black oak	White oak	Scarlet oak	Northern red oak	Chestnut oak	Other species
1	2-5	••	••	•			••
	6-11		•				•
	12-16						•
	17+				•		
2	2-5	••	⫬				
	6-11	•	••				••
	12-16		•				
	17+						
3	2-5	•	•	••			•
	6-11			•			
	12-16		•				•
	17+						
4	2-5		••				••
	6-11						
	12-16	••		•			••
	17+						
5	2-5		⫬	••			
	6-11	•	••				
	12-16						
	17+		•				
6	2-5	•	••	••			••
	6-11						•
	12-16	••	•				•
	17+						
7	2-5	••	••	••			
	6-11		•				••
	12-16						•
	17+	•					
8	2-5	••	•	•	••		••
	6-11	•					
	12-16	•			•		
	17+						
9	2-5		••				••
	6-11	•			•		•
	12-16	••	•	•			•
	17+						
10	2-5	••	⫬	•			
	6-11		•		•		•
	12-16	••					
	17+						
Total No. per acre	2-5	26	60	24	4		
	6-11	8	12	2	4		22
	12-16	18	8	4	2		14
	17+	2	2	0	2		0
	Total	54	82	30	12		62
No. of stump sprouts per acre	2-5	22	48	24	4		
	6-11	5	6	2	2		
	12-16	4	4	2	1		
	17+	0	0	0	0		
	Total	31	58	28	7		

Total
140
48
46
6
240
Total per acre
124

Date_____
Compartment 1
Stand 1

1/735-acre plots
Total No. 40
Stocked ⊠ ⊓
Not Stocked ⊠ ⊠ ::
Percent Stocked 43

Adv. Repro. Adequate No

Adv. Repro. + stump sprouts Adequate Yes

Table 41.1 Advance oak reproduction required for full stocking.*

	Number of Seedlings/Saplings per Acre			
Aspect	NE	SW	NW	Level
Slope	Lower	Mid	Mid	< 15 percent
Height (ft.)				
< 1	?	22,000	11,000	11,000
2	22,000	3,675	2,450	2,450
4	4,400	880	600	600
6	2,750	440	340	340
8	1,050	330	275	275
10	1,050	300	250	250

* Prepared by Rod Jacobs, North Central For. Exp. Sta., St. Paul, MN, from data presented in Sander et al. (1984).

Table 41.2 Recommended rotation lengths[1] and diameters for oak sawtimber under intensive management (Sander, 1977).

Site index class (feet)	Rotation length (years)	Rotation diameter[2] (inches)
75+	60-75	24-28
55-74	75-90	20-24
40-54	90-120	16-18

[1] Rotation lengths for pulpwood are about one-half to two-thirds of those for sawtimber. Rotations may be extended to meet ownership objectives.

[2] Average diameter of crop trees.

Table 41.3 Expected percentage of oak stumps that will sprout after cutting.[1]

Size class (inches)[2]	Black oak	Scarlet oak	Northern red oak	White oak	Chestnut oak
2-5	85	100	100	80	100
6-11	65	85	60	50	90
12-16	20	50	45	15	75
17+	5	20	30	0	50

[1] Excerpted from Sander (1977).

[2] DBH class of parent tree.

PEST MANAGEMENT GUIDELINES FOR OAK WISCONSIN DNR, FOREST PEST MANAGEMENT

HAZARD	LOSS OR DAMAGE	PREVENTION, MINIMIZING LOSSES AND CONTROL ALTERNATIVES	REFERENCES
FOLIAGE PESTS			
Anthracnose	Occasional spring defoliation which may be severe enough to cause loss of vigor and susceptibility to other organism.	No practical prevention or control practices. Fertilization may restore vigor. Monitor severely infected stands for signs of decline and consider harvest if necessary.	Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury. 1980. J.D. Solomon, et al. USDA Forest Service General Report SA-GR11.
SPRING DEFOLIATORS			
Cankerworms Oak Leaf Roller Oak Leaf Tier Forest Tent Caterpillar	Periodic outbreaks cause heavy defoliation in spring which invites attack by two-lined chestnut borer and shoe-string root rot. Outbreaks often occur where oaks are under stress due to drought soils, overstocking, competition from shade tolerant species or over-maturity.	ALTERNATIVES: 1. Maintain proper stocking levels. 2. Harvest when mature. 3. Control competition. 4. Protect foliage with insecticide. 5. Accept defoliation and monitor for decline and harvest when necessary.	Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury. 1980. J.D. Solomon, et al. USDA Forest Service General Report SA-GR11.
Iron Deficiency Chlorosis	Interveinal yellowing of leaves of one branch or entire tree caused by inability of roots to take up iron because of high soil pH, soil disturbance, or root damage. Seriousness varies from year to year. Some growth loss is normal; branch and tree mortality occur in extreme cases. Older trees are more susceptible.	Seldom serious enough to require action. ALTERNATIVES: 1. Harvest mature oaks. 2. In extreme cases, convert to a less susceptible type.	Oak and Other Trees Disorder: Iron Chlorosis. J.R. Love. 1975. University of Wisconsin Extension, Urban Phytonarian A2638.
Gypsy Moth	Summer defoliation (late June, early July) occurs in widespread outbreaks lasting 3-10 years. Two or more years of heavy defoliation may cause decline and mortality of oak, and attack by two-lined chesnut borer.	ALTERNATIVES: ON HIGH RISK SITES: 1. Reduce oak and favored component to 25% or less. 2. Convert to unfavored type or nontimber type. 3. Accept risk of defoliation.	Gypsy Moth: Forest Influence. R.W. Campbell. 1979. USDA Forest Service Agr. Info. Bull. 423. Guides for Predicting Gypsy Moth Damage for Forest Landowners. USDA Forest Service. NAFB/P-25.

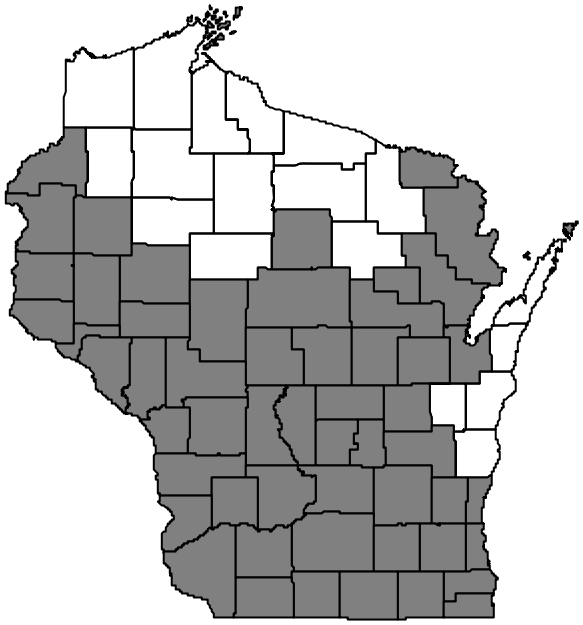
	HAZARD ZONE: South of Eau Claire, Wausau, Marinette. FAVORED FOOD: Oak basswood, aspen, white birch, willow. HIGH RISK SITES: Upland, droughty sites with favored food trees in low-vigor, open-grown stands.	ON LOW-RISK SITES: 1. Maintain proper stocking levels. 2. Remove "wolf" trees. CURRENT OR IMPENDING OUTBREAKS: 1. Monitor high-risk sites for rising populations. 2. Spray rising populations to prevent outbreak. 3. Allow population to rise and spray to protect foliage. 4. Accept defoliation and monitor for decline.	The Gypsy Moth: Research Toward Integrated Pest Management. C.C. Doane, ed. 1981. USDA Tech. Bull. 1584. 757 pp.
LATE SUMMER DEFOLIATORS:			
Oak Skeletonizer Red Humped Oakworm Orange-striped Oakworm Variable Oakleaf Caterpillar Walkingstick Oak Grasshopper Actinopelte Leafspot	Infrequent outbreaks of late summer defoliation seldom last more than one year. Normally of little concern. However, complete defoliation may initiate branch dieback and decline of low-vigor trees, especially on droughty sites.	No practical prevention. Insecticide application seldom necessary.	Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury. 1980. J.D. Solomon, et al. USDA Forest Service General Report SA-GR11.
Oak Decline	Twig, branch and tree mortality brought on by various stresses especially defoliation.	Maintain vigorous, well-stocked stands. Protect from defoliation. On especially droughty site, convert to alternate species.	Stress Triggered Tree Diseases, The Diebacks and Declines. D.R. Houston. 1981. USDA Forest Service NE-INF-41-81.
MAIN STEM PESTS			
Oak Wilt	Individual tree and group mortality in spreading pockets. Red oaks more susceptible than white oaks.	Prevent wounding during growing season, especially April-July. PREVENT SPREAD VIA ROOT GRAFTS: 1. Cut roots with trenching machine and remove all trees on diseased side of trench. 2. Create root graft barrier with soil fumigant. 3. Kill ring of trees outside growing oak wilt pocket with a frill or cut-stump herbicide application. (This method is not	Oak (***Quercus***) Disorder: Oak Wilt 1986. G. Worf. 1978. Univ. of Wisconsin Extension Leaflet A1693.

		very effective. It only delays the spread of oak wilt.) 4. Consider conversion to alternate species. If valuable species such as red or white pine are growing under oak, then the presence of oak wilt may act as a beneficial agent, releasing the pine.	
Two-lined Chestnut Borer	Branch and individual tree mortality in pole to sawlog sized trees occurring as scattered individuals and in pockets. Attack usually due to stress: 1. Trees stressed by drought, overstocking, disease or overmaturity die from top down in two or three years. 2. Trees stressed by defoliation in spring may die in fall of same year. 3. Trees stressed by droughty site.	1. Maintain vigorous, well-stocked stands; harvest at or before maturity; remove individual low-vigor trees during thinnings. 2. Harvest dead and partially dead trees before following spring. This will remove the overwintering borer population and reduce but not eliminate risk of further attack. Trees that die in August or September will suffer no wood stain or decay if utilized before following growing season. 3. Consider conversion to alternate species: a. On sandy soil: Red, Jack or white pine. b. On heavier soil: White pine or alternate.	Oak Disorder: Two-lined Chestnut Borer. D. Hall. 1977. UW Extension Urban Phytonarian A2902.
WOOD BORERS			
White Oak Borer Red Oak Borer Carpenter-worm	Tunneling in wood causes serious lumber degrade and decay entry. Attacked trees are often suppressed or diseased.	Maintain vigorous, well-stocked stands. Remove suppressed and other unhealthy trees. Remove brood trees. Avoid wounding. On poor sandy sites, consider conversion to pine or mixed pine oak type.	Bionomics and Control of the White Oak Borer. J.D. Solomon, et al. USFS Res. Paper 50-198. Life History of the Red Oak Borer in White Oak. J.R. Galford. 1983. Ent. News, 94:7-10.
ROOT PESTS			
Shoestring Root Rot (***Armillaria mellea***)	Root loss and tree mortality of pole to sawlog sized trees often following drought or defoliation.	Maintain vigorous well-stocked stands. Harvest mature trees.	Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury. 1980. J.D. Solomon, et al. USDA Forest Service General Report SA-GR11.

Guidelines for cutting oak to minimize overland spread of oak wilt.

The following guidelines are proposed for counties where the presence of oak wilt has been confirmed plus Lincoln County. No restrictions are recommended for the counties where oak wilt has not been confirmed.

April 15 - July 1
No pruning or cutting of oak except in low risk situations.[2]
July 2 - April 14
No restrictions.



Counties where oak wilt management guidelines apply - 2003.

[2] The following low risk scenarios describe cutting that may be conducted at any time due to the low risk of increasing the overland transmission of oak wilt.

1. Any cutting where oaks (5" + size class) represent <10% of the forest tree composition in a fully or overstocked stand.
2. Clearcutting patches of oaks when the adjacent forest cover types do not have a significant oak composition (oaks in 5"+ size class represent <10% of the forest tree composition in a fully or overstocked stand.)